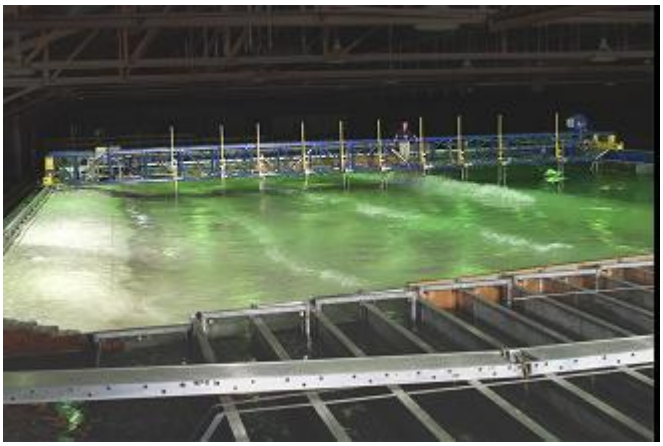
US Army Corps of Engineers®
Engineer Research and Development Center

Large-Scale Sediment Transport Facility

Description

The Large-Scale Sediment Transport Facility (LSTF) is a state-of-the-art, mobile-bed laboratory facility operated by ERDC's Coastal and Hydraulics Laboratory, which is capable of reproducing surf zone processes found on natural beaches. The LSTF simulates nearshore hydrodynamic and sediment transport processes at a relatively large geometric scale, including situations where considerable sand is mobilized and transported in suspension.



The Large-Scale Sediment Transport Facility

The LSTF is the only laboratory facility that has studied longshore swash transport. Additionally, the facility provides an ideal setting to measure detailed surf zone hydrodynamics and several researchers have used the LSTF for hydrodynamic model development.

The LSTF is available to U.S. Army Corps of Engineers Districts, public agencies, and private engineering consultants and design firms for testing and developing shore protection methods for use in all levels of coastal project design and maintenance and coastal sediment management.

Specifications

The facility consists of a 30-m-wide-, 50-m-long-, 1.4-m-deep-basin and includes wave generators, a sand beach, a recirculation system, an instrumentation bridge, and sand traps. Waves are generated using four synchronized unidirectional spectral wave generators. A longshore current control system, which includes 20 independent vertical turbine pumps, recirculates the prescribed longshore current distribution. The mobile, programmable instrumentation bridge spans the beach in the cross-shore. The bridge serves as a platform for visual observations and for mounting a cross-shore array of wave gauges, acoustic Doppler velocimeters, arrays of fiber-optic backscatter sensors, and a rapidly sampling beach profiler. A series of 20 sediment traps are located in flow channels at the downstream end of the facility. Traps are suspended from load cells, and the weight of sand that accumulates in each trap is recorded, which allows calculation of the cross-shore distribution of longshore transport.

Benefits

The LSTF is used to improve existing longshore sediment transport predictive equations, obtain data for development and enhancements to numerical models, evaluate and modify conceptual designs for coastal protection, and perform site-specific studies for coastal protection. The results lead to more effective designs and cost savings.

Application

Research performed in the LSTF led to development of a physics-based model to calculate the cross-shore distribution of longshore transport rates. Additionally, the model also predicts cross-shore distribution of wave height, longshore, and cross-shore currents. The research was a collaborative effort between the Navigation Systems Research Program and the Massachusetts Institute of Technology.

NEARHYDS, a numerical model that accurately predicts the cross-shore distribution of longshore currents, was developed from LSTF hydrodynamic data under the Navigation Systems Research Program.

Enhancements to the GENESIS shoreline change model have been implemented from experiments conducted in the LSTF as part of the Coastal Inlets Research Program. Incorporation of notched groins, detached breakwaters, and T-Head breakwaters into GENESIS resulted from experiments in the facility.

Detached Breakwater Study

The Naval Research Laboratory utilized the LSTF to develop a model to simulate inner surf and swash zone flows. Capabilities of the model include prediction of the free surface, fluid velocities, acceleration, pressure, pressure gradients and bed shear stresses.

The University of Delaware applied LSTF data in the development of a nearshore sediment transport model and a kinematics wave model, which were both incorporated into the SHORECIRC model.

Stevens Institute of Technology performed experiments with simulated geotextile tubes to mold the bottom contours and promote sandbar formation in a manner that enhances wave breaking favorable for surfing, while providing an adequate level of shore protection at Monmouth Beach, New Jersey.

Experiments examining the fate of nearshore placed dredged material performed for the US Army Engineer District, Buffalo and Dredging Operations and Environmental Research Program. The study showed that nearshore placed material remained in the surf zone and moved onshore and downdrift of the original placement site.

Nearshore Mound Study

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Partners

US Army Corps of Engineers Navigation Systems Research Program, Dredging Operations and Environmental Research Program and Coastal Inlets Research Program; Naval Research Laboratory, University of Delaware, Massachusetts Institute of Technology, Stevens Institute of Technology.